



Complications after lower body contouring surgery due to massive weight loss unaffected by weight loss method

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Summary Body contouring surgery following massive weight loss positively affects a patient's quality of life. However, the procedure is prone to complications. Herein, we stratified complications timewise. Furthermore, we examined whether the weight loss method – bariatric surgery or lifestyle changes – affected the frequency or severity of complications. In this single-centre retrospective analysis, we included 158 patients with massive weight loss undergoing body contouring surgery between 2009 and 2015. We recorded 96 complications in 80 patients, with an overall rate of 51%. Most complications (80.2%) were minor (Clavien-Dindo grades 1 and 2) and superficial wound infections. Immediate complications (0–24 hours post-operation) affected 8.3% of patients, with early complications (1–7 post-operative days) affecting 16.7% of them and late complications (8–30 post-operative days) affecting 58.3% of them. We found no statistical difference in complication rates when comparing bariatric and non-bariatric patients. Older age ($p=0.042$) at operation is associated with an increased risk for immediate haematoma or bleeding requiring surgery. Among early complications, a high maximum weight ($p=0.035$) and a high preoperative weight ($p=0.0053$) significantly correlated with a haematoma or bleeding requiring surgery. For late complications, seroma correlated with older age ($p=0.0061$). Complications are primarily minor and non-life threatening after body contouring surgery because of frequent massive weight loss. Here, no particular subgroup of massive weight loss patients appeared more prone to complications. Thus, for each patient, the risks associated with body contouring surgery following massive weight loss should be considered individually.

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Introduction

Loose, hanging skin is a well-known consequence following massive weight loss.¹ Excess skin folds may lead to

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intertrigo, ulceration, infection and oedema.^{2,3} These issues may cause physical problems hindering daily life, and patients may find excess skin psychologically and socially inhibiting.⁴⁻⁶ Furthermore, excess skin may also cause difficulty in using well-fitting clothes and greatly affect intimacy, possibly triggering major body image dissatisfaction or depression.^{4,7}

Loose, excess skin is most commonly located in the mid-body,^{2,8} although it can be present in many other regions of the body.⁹ These contour deformities are resistant to exercise and diet.⁸ The only efficient intervention is removing excess skin surgically.⁸ Thus, procedures focusing on the abdomen and lower back or buttocks area are common following massive weight loss.^{8,10} Along the anterior lower body, abdominoplasty represents the most common procedure to reconstruct contour deformities.¹¹⁻¹³ If the posterior part of the lower body is also affected, a circumferential procedure also known as a belt lipectomy is employed.¹¹ Whilst a large amount of variations exist across procedures,¹⁴⁻¹⁶ ultimately, dermolipectomy is employed to excise excess skin.

According to the literature, post-operative complications in body contouring surgery occur because of frequent massive weight loss, ranging from 28% to 78%.^{11-13,20} The majority of complications are minor.^{11,12,20} Significant risk factors for post-operative complications following body contouring surgery include a high pre-surgical BMI, a high American Society of Anesthesiologists (ASA) score, the amount of excess weight loss, the amount of tissue removed, intra-operative hypothermia, male gender, older age, smoking and comorbidities such as diabetes and hypertension.²¹⁻²⁶ Furthermore, bariatric surgery itself induces malabsorption and nutritional imbalance,¹⁷ thus increasing the complication rate in post-bariatric patients.^{18,19} Particularly, post-bariatric surgery patients have a 60% to 87% increased risk of complications compared with non-bariatric surgery patients who lost weight through changing their dietary habits or through exercise.²⁷

Lifestyle changes along with diet for weight loss and increased exercise is foundation to any weight loss²⁸. However, in advanced cases, bariatric surgery, especially laparoscopic procedures, results in weight loss with reduced complication rates²⁸. Bariatric procedures can be categorised as procedures restricting the amount of food such as gastric banding and sleeve gastrectomy, thereby causing malabsorption such as biliopancreatic diversion with duodenal switch, or by a combination of both restriction and malabsorption such as Roux-en-Y gastric bypass. The current study aimed to examine complications following lower body contouring surgery due to massive weight loss in a single centre. We sought to stratify the complications according to their severity and time of occurrence. Furthermore, we aimed to study whether the method of weight loss – either bariatric surgery or lifestyle change – affected the frequency and severity of complications.

Patients and methods

The hospital's institutional review board approved this retrospective chart review study and its protocol.

The hospital's electronic database Opera® within the Department of Plastic Surgery, Helsinki, Finland, was queried for patients who underwent either abdominoplasty or belt lipectomy during the period from January 1st 2009 to December 31st 2015. We included only patients with massive weight loss through either bariatric surgery or lifestyle change. We excluded patients whose indication for abdominoplasty was post-pregnancy.

Computerised medical records were reviewed in detail, and the data reviewed for each patient included the following: age, gender, comorbidities (such as arterial hypertension and type 2 diabetes dyslipidaemia), former abdominal surgery, smoking (current smoker, former smoker and non-smoker), highest lifetime weight and BMI and weight loss method (surgical or non-surgical).

The body contouring surgery specific variables consisted of age, weight and BMI on the body contouring surgery day; the specific procedure and the operative time for body contouring. We also noted the haemoglobin rate before and after surgery, the duration of hospital stay, institutional discharge and any complications. The documentation of complications consisted of wound infections, wound dehiscence, seroma, haematoma or wound bleeding, deep-tissue infection, skin necrosis, deep vein thrombosis, embolism and sepsis.

We grouped complications into four categories on the basis of their occurrence: immediate complications occurred 0 to 24 hours after the body contouring procedure, early complications occurred 1 to 7 days after surgery, late complications from 8 to 30 days after the procedure and complications requiring readmission.

Patients were divided into two groups using the weight loss method employed. Those who lost weight through bariatric surgery were placed in the bariatric group and those who lost weight through a lifestyle change were placed in the non-bariatric group.

Finally, all complications were divided into five grades according to the Clavien-Dindo classification.²⁹

Statistical methods and analysis

Statistical analysis was conducted using NCSS 2007 (NCSS Statistical Software, Kaysville, UT, USA) and SPSS Statistics version 19.0 (IBM Corporation, NY, USA). We considered *p* values of less than 0.05 as statistically significant.

The comparisons between the bariatric and non-bariatric groups were analysed using the Chi-square test, whereas continuous variables were analysed using Student's *t*-test and the Mann-Whitney U-test. Risk factors for complications were analysed using Fisher's exact test.

To study the risk factors for any complication occurring at any time point, we employed chi-square test for categorised risk factors - gender, method of weight loss, diabetes, arterial hypertension, dyslipidaemia, former abdominal surgery and smoking. Many risk factors - age, highest lifetime weight and BMI, weight and BMI on the body contouring surgery day and operative time for body contouring - were analysed with the Mann-Whitney test.

To analyse further the method of weight loss on the rate of complications, we employed the matched-pairs test. The patients were stratified according to the weight loss method

Table 1 Demographic characteristics of massive weight loss in 158 patients who underwent lower body contouring surgery after massive weight loss. p values denote the correlation between bariatric and nonbariatric patients.

	All	Bariatric	Nonbariatric	p value
N	158	90 (57.1)	68 (43.3)	0.388137
Female (%)	117 (74.1)	69 (76.7)	48 (70.6)	
Male (%)	41 (25.9)	21 (23.3)	20 (29.4)	
Mean age in years (range) at body contouring surgery				
All	44.8 (22-72)	46.0 (24-64)	43.0 (22-72)	0.090989*
Male	46.7 (22-72)	48.9 (24-64)	44.3 (22-72)	
Female	44.1 (22-72)	45.1 (24-62)	42.5 (22-72)	
Maximum weight, mean kg (range)	136.5 (79-285)	139.5 (96-285)	132.4 (79-267)	0.11607
Maximum BMI, mean (range)	47.6 (31.90-90.97)	49.0 (37-90.97)	45.8 (31.90-82.41)	0.00693*
Outpatient visit for body contouring surgery				
Weight, mean kg (range)	83.3 (55-150)	83.2 (55-150)	83.5 (60-132)	0.828916
BMI, mean (range)				
Weight loss, mean kg (range)	54.4 (9.4-157.0)	56.8 (27.5-135)	51.2 (9.4-157)	0.0124*
Risk factors for complications				
Diabetes mellitus (%)	39 (24.7)	28 (31.1)	11 (16.2)	0.0311105*
Arterial hypertension (%)	63 (39.9)	45 (50)	18 (25.6)	0.002783*
Hyperlipidaemia	37 (23.4%)	26 (28.9%)	11 (16.2%)	0.061725
Smoking status				
Active smoker	28 (17.7%)	21 (23.3%)	7 (10.3%)	0.030483*
Ex-smoker	22 (13.9%)	15 (16.7%)	7 (10.3%)	
Abdomen surgery before	69 (43.7%)	39 (43.3%)	30 (44.1%)	0.921600

* indicates a statistically significant finding.

and were matched with age, ± 5 years, and gender. McNemar's test was used to examine the paired nominal data, and statistically significant p-values denote differences in the cohorts.

Results

All patients

The specific inclusion criteria resulted in a sample of 158 patients, consisting of 117 women (74.1%) and 41 men (25.9%), with age ranging from 22 to 72 years and a mean age of 44.8 years. In total, 90 patients (57%) lost weight through bariatric surgery and 68 (43%) through lifestyle changes.

Table 1 summarises patient demographic characteristics and provides a comparison between the two groups. For all patients, the mean highest lifetime weight was 136.5 kg and the mean highest lifetime BMI was 47.6 kg/m², with a mean weight loss of 54.4 kg. The majority of them, i.e. 112 patients (70.9%), underwent abdominoplasty and 46 (29.1%) had a belt lipectomy. Twenty-eight of them (17.7%) were current smokers, 63 (39.9%) had hypertension, 39 (24.7%) had diabetes and 37 (23.4%) had hyperlipidaemia.

Bariatric group

A total of 90 patients (57.1%) were included in the bariatric group, with a mean age of 46 years, ranging from 24 to 64 years. The mean time between bariatric surgery and body contouring surgery was 2.69 years. The most common bariatric procedure was gastric bypass in 75 patients (83.3%), followed by gastric sleeve surgery in 14 patients

(15.5%), and gastric balloon surgery in 1 (1.1%). The mean highest lifetime weight was 139.5 kg and the mean highest lifetime BMI was 49.0 kg/m². Mean weight loss in the bariatric group reached 56.8 kg, ranging from 27.5 to 135 kg. The mean weight at the first plastic surgery outpatient clinic visit was 83.2 kg, ranging from 55 to 150 kg. In total, 60 (66.7%) patients underwent abdominoplasty and 30 (33.3%) patients underwent belt lipectomy.

Non-bariatric group

There were 68 patients (43.3%) in the non-bariatric group, with a mean age of 43 years, ranging from 22 to 72 years. The mean highest lifetime weight reached 132.4 kg and the mean highest lifetime BMI was 45.8 kg/m². Mean weight loss reached 51.2 kg, ranging from 9.4 to 157 kg. The mean weight at first plastic surgery outpatient clinic visit was 83.5 kg, ranging from 60 to 132 kg. In total, 52 (76.5%) patients underwent abdominoplasty and 16 (23.5%) patients underwent belt lipectomy.

Comparison of the bariatric and non-bariatric groups

Using the Chi-square test, we found no significant difference between the bariatric and non-bariatric groups with regard to the mean age ($p=0.090$), maximum weight before weight loss ($p=0.116$), dyslipidaemia ($p=0.0167$), arterial hypertension ($p=0.0167$) or any abdominal surgery before contouring surgery ($p=0.92$). A comparison of groups showed significant differences in the maximum

Table 2 Number and stratification of recorded complications, n = 96.

		All, n (%)	Immediate complication, n	Early complication, n	Late complication, n	> 30 postoperative days, n
Wound related	Wound infections	18 (18.8)	0	1	14	3
	Wound dehiscence	3 (3.1)	0	0	3	0
	Skin necrosis	3 (3.1)	0	0	2	1
	Suture fistula	12 (12.5)	0	0	5	7
Bleeding related	Post-operative hematoma, not requiring any intervention	5 (5.2)	0	2	3	0
	Post-operative haematoma, needing transfusion	8 (8.3)	4	4	0	0
	Post-operative bleeding, with surgical intervention	9 (9.4)	4	5	0	0
Seroma	Seroma	23 (24.0)	0	2	18	3
Infectious complications	Deep tissue infection	13 (13.5)	0	2	10	1
	Systemic infection	1 (1)	0	0	1	0
Pain	Pain	1 (1)	0	0	0	1

Table 3 Complications stratified by Clavien-Dindo classification.

	I	II	IIIa	IIIb	IVa	IVb
Wound infection (n = 18)	4	14	0	0	0	0
Wound dehiscence (n = 3)	1	2	0	0	0	0
Post-operative haematoma (n = 22)	5	8	0	9	0	0
Seroma (n = 23)	22	0	0	1	0	0
Skin necrosis (n = 3)	1	0	2	0	0	0
Deep tissue infection (n = 13)	0	6	3	4	0	0
Systemic infection (n = 1)	0	1	0	0	0	0
Fistula (n = 12)	12	0	0	0	0	0
Post operative pain (n = 1)	1	0	0	0	0	0

BMI ($p=0.00693$) and total weight loss ($p=0.0124$). Furthermore, the non-bariatric group contained fewer patients with diabetes ($p=0.0311$), less arterial hypertension ($p=0.0028$) and fewer current smokers ($p=0.03048$).

All complications

We identified a total of 96 complications in 80 patients (Table 2). Thus, the overall complication rate was 51%. In the majority, i.e. 64 patients (80%), only one complication was recorded, followed by 16 patients (20%) with two complications. The complications were graded as follows using the Clavien-Dindo classification: 46 grade 1 (47.9%), 31 grade 2 (32.3%), 5 grade 3a (5.2%) and 14 grade 3b (14.6%). No grade 4 or grade 5 complications were recorded (Table 3).

Most complications that occurred in 77 (80.2%) cases were minor, which were Clavien-Dindo grades 1 and 2. Major complications, Clavien-Dindo grades 3a and 3b, occurred in 19 (19.8%) cases.

Complications due to infections were recorded in 32 (33%) cases, thus representing infections as the most com-

mon cause. Superficial wound infections were recorded in 18 (18.8%) cases, deep-tissue infections occurred in 13 (13.5%) cases and systemic infection occurred in 1 (1%) case.

The second most common complication was seroma, recorded in 23 (24%) cases. Most seromas occurred for a minimum of 8 days post-operatively. Two cases of seroma, however, occurred before 8 post-operative days and three cases occurred 30 days after the surgery.

Post-operative bleeding-related complications represented the third most common occurrence, found in 22 cases (23%). A post-operative haematoma was noted in five cases and was left to resolve without any intervention. In nine cases, post-operative bleeding needed surgical intervention with a blood transfusion, whereas eight cases relied only on a blood transfusion to resolve.

Immediate complications (0-24 hours post-operatively) were recorded in 8 (8.3%) cases. Early complications (1-7 days post-operatively) occurred in 16 (16.7%) cases and late complications (8-30 days post-operatively) occurred in 56 (58.3%) cases. Complications that occurred for more than 30 days post-operatively were recorded in 16 (16.7%) cases, typically due to suture fistula in seven cases.

Table 4 Complications stratified by the method of weight loss and lower body contouring surgery.

	Bariatric group complications, n=31 (%)	Non-bariatric group complications, n=34 (%)	
Wound infections	3 (10)	9 (26)	Abdominoplasty
Wound dehiscence	1 (3)	2 (6)	
Skin necrosis	2 (6)	1 (3)	
Fistula	6 (19)	1 (3)	
Post-operative haematoma	5 (16)	5 (15)	
Seroma	8 (26)	9 (26)	
Deep tissue infection	5 (16)	7 (21)	
Systemic infection	1 (3)	0 (0)	
	Bariatric group complications, n=19 (%)	Non-bariatric group complications, n=10 (%)	
Wound infection	5 (26)	1 (10)	Belt lipectomy
Wound dehiscence	0 (0)	0 (0)	
Skin necrosis	0 (0)	0 (0)	
Fistula	1 (5)	3 (30)	
Post-operative haematoma	6 (32)	6 (60)	
Seroma	6 (32)	0 (0)	
Deep tissue infection	1 (5)	0 (0)	
Systemic infection	0 (0)	0 (0)	

Risk factors for complications

We found no statistical difference in terms of the complications when comparing the bariatric and non-bariatric groups. Statistically significant risk factors consisted of an older age ($p=0.042$) at operation for immediate haematoma or bleeding needing surgical intervention. For early complications, a high maximum weight ($p=0.035$) and a high preoperative weight ($p=0.0053$) significantly correlated with a haematoma or bleeding needing surgical intervention. For late complications, the occurrence of seroma correlated with older age ($p=0.0061$). We failed to determine any statistically significant risk factors for any complication at any time point.

For matched-pairs test, we established two groups with 45 patients by the method of weight loss, age, and gender match. The statistical pair analysis did not reveal differences in complications by the method of weight loss.

Comparison of abdominoplasty and belt lipectomy

We found no differences in wound-related complications. However, we found a slight statistical difference in the rates of post-operative bleeding and surgical intervention in the belt lipectomy group ($p=0.0043$). Table 4 summarises the complications according to weight loss methods and lower body contouring surgery procedure.

Discussion

Here, we described our experience with lower body contouring surgery complications among patients with massive weight loss, thus contributing to the literature in this study of 158 patients. In agreement with previous studies, our

overall complication rate was 51.3%. The majority (80.2%) of complications consisted of minor issues and grade 1 and 2 complications according to the Clavien-Dindo classification. Furthermore, most of our patients experienced only one complication. We recorded no life-threatening complications or deaths.

Our most common complications were superficial infection-related complications, followed by seromas and bleeding. Our findings agree well with those reported in previous studies. In the previous literature, the single most common post-operative complication following lower body contouring surgery consists of seromas, thus accounting for approximately 5% to 15% of all complications,^{11-13,22} followed by wound-related problems,²² such as dehiscence^{11,20} and skin-edge necrosis.¹³ Other complications include haematomas, lymphoceles, deep vein thromboembolism, pulmonary embolism, lymphedema, post-operative anaemia and nerve injuries.^{20-23,30} When comparing abdominoplasty and belt lipectomy, we found no statistically significant difference in wound healing complication rates. Thus, given our current results, we conclude that most patients would benefit from belt lipectomy – that is, correcting both the anterior and posterior parts of the body.

Body contouring after massive weight loss is prone to complications whereby the proportion of all complications is typically high reaching up to 70%.^{11,12,20,31-33} It seems that the vast majority of complications are minor. However, only a few recent studies^{12,20} have applied a systematic approach to classify complications such as the Clavien-Dindo classification. In our study, more than 75% of the complications were classified as late, that is, occurring 7 to 30 days post-operatively. These primarily consisted of seromas or wound problems.

In this study, non-bariatric patients comprised 43% of all patients. This figure is somewhat larger than those obtained in previous studies, whereby the percentage of non-

bariatric patients typically ranges from 9% to 18%.^{20,31,33,34} However, contrary to previous studies, wherein post-bariatric surgery patients have a 60% to 87% increased risk of complications compared with non-bariatric patients who lost weight through changes in dietary habits or through exercise,²⁷ our results contradict this somewhat. Our groups comparing bariatric and non-bariatric patients were similar in terms of both weight and weight loss. Although the two groups may seem heterogeneous, our statistical analyses showed that the groups were similar regarding the complications.

Changes in diet and lifestyle habits play an important role in weight loss. Some obese individuals are not able to lose weight through dietary changes and through exercise, and hence, they must resort to bariatric surgery. Furthermore, bariatric surgery represents the most effective treatment for morbid obesity. Following bariatric surgery, individuals tend to experience significant improvements in obesity-related comorbidities.³⁵ Thus, in this study, we found no previous comorbidities affecting or presenting as risk factors for complications. Instead, we found that older age, a higher maximum weight and a higher preoperative weight were risk factors for complications such as bleeding and seroma.

We should also consider the limitations of this study. First, the limited number of patients and the drawbacks inherent to retrospective studies represent the foremost limitations to our study. Reviewing clinical diagnostic impressions from medical records, specifically those not intended for research, is prone to investigator bias. However, the strength of this study lies in the comparability of the bariatric and non-bariatric groups and the comprehensive documentation of complications across all patients.

To conclude, complications following body contouring surgery are due to frequent massive weight loss, although most are minor and non-life threatening. In this study, we found no particular subgroup of patients with massive weight loss particularly prone to complications. Hence, for each patient, the risks for body contouring surgery following massive weight loss should be considered individually. In particular, our results also favour the comprehensive contouring of both the anterior and posterior parts of the body.

Conflict of Interest Statement

All authors declare no financial conflicts of interest with regard to the data presented in this manuscript. This research was funded by departmental sources only.

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